

Example of a Terrestrial Ecological Assessment Using the Terrestrial Toxicity Database, the SCF Soil, WCF Surface Water, and SCF Sediment Modules along with the TWEM and WEAP Models (Example No. 7)

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Introduction

The U.S. Army Engineer Research and Development Center (ERDC) developed the Adaptive Risk Assessment Modeling System (ARAMS™) to provide the Army with the capability to perform human and ecologically based risk/hazard assessments associated with past practice and current activities at military installations. The intent of the system is to provide a platform from which a variety of assessments can be performed. The system is envisioned to help a risk analyst visualize an assessment from source, through multiple environmental media (e.g., groundwater, surface water, air, and land), to sensitive receptors of concern (e.g., humans and ecological endpoints).

ARAMS uses the Framework for Risk Analysis in Multimedia Environmental Systems (FRAMES) developed by the Pacific Northwest National Laboratory (PNNL) for linking disparate objects, such as environmental fate/transport models, databases, spreadsheets, etc. FRAMES is a Windows-based software platform that provides an interactive user interface and, more importantly, specifications to allow a variety of DOS and Windows-based environmental codes to be integrated within a single framework.

This document is intended to serve as a tutorial for helping new users with the application of ARAMS/FRAMES and the components within this system. This example does not include the steps for project planning and the use of associated tools under the “File” menu. These tools help the user plan the risk assessment including development of the conceptual site model and the Risk Assessment Guidelines for Superfund (RAGS) Part D Table 1 for human health risk assessment. There are several Help files within ARAMS that explain these tools.

Example Description

This example uses the Wildlife Ecological Assessment Program (WEAP), the Terrestrial Wildlife Exposure Model (TWEM), the Terrestrial Organism Selector (TOS), the Terrestrial Toxicity Database (TTD), the SCF Soil Module, the WCF Surface Water Module, and the SCF Sediment Module. The latter three modules are located under the User Defined object. This is a steady-state analysis, i.e., media concentrations do not vary over time, which is appropriate when the assessment is concerned with only present conditions. Note that at this time, TWEM does not allow time-varying analyses. The primary reason for this example is to demonstrate the use of TWEM and TTD.

The assessment begins with selecting constituents of concern, the target organisms (using TOS), and the toxicity reference values (TRVs) using TTD. Known concentrations for water, sediment, and soil media are entered using the User-Defined object. TWEM, a model that estimates exposure of terrestrial wildlife receptors to organic and inorganic chemicals in soil, water, sediment, and biota, is used to calculate exposure (i.e., dose, mg/kg/day) to the terrestrial receptors. WEAP is a software package that summarizes ecological health impacts to various organisms from exposures to constituents. WEAP uses the ratio of exposure dose and toxicity reference value (TRV, e.g., No Observable Adverse Effects Level, NOAEL) from the TTD database (or other sources) to define Ecological Hazard Quotients (EHQs). Time-varying EHQs are reported, even if constant as in this steady-state analysis, since ARAMS/FRAMES allows for time-varying analyses. Probabilities of Exceedence (i.e., equal to or greater than), based on time series analysis, are calculated, as they relate to exposure dose levels and EHQs. The constituent that will be evaluated is “DDT.” The ecological receptors will be “Red Fox” and

“Belted Kingfisher.” Each of the objects used for this example are shown in Figure 1 within the FRAMES object working space.

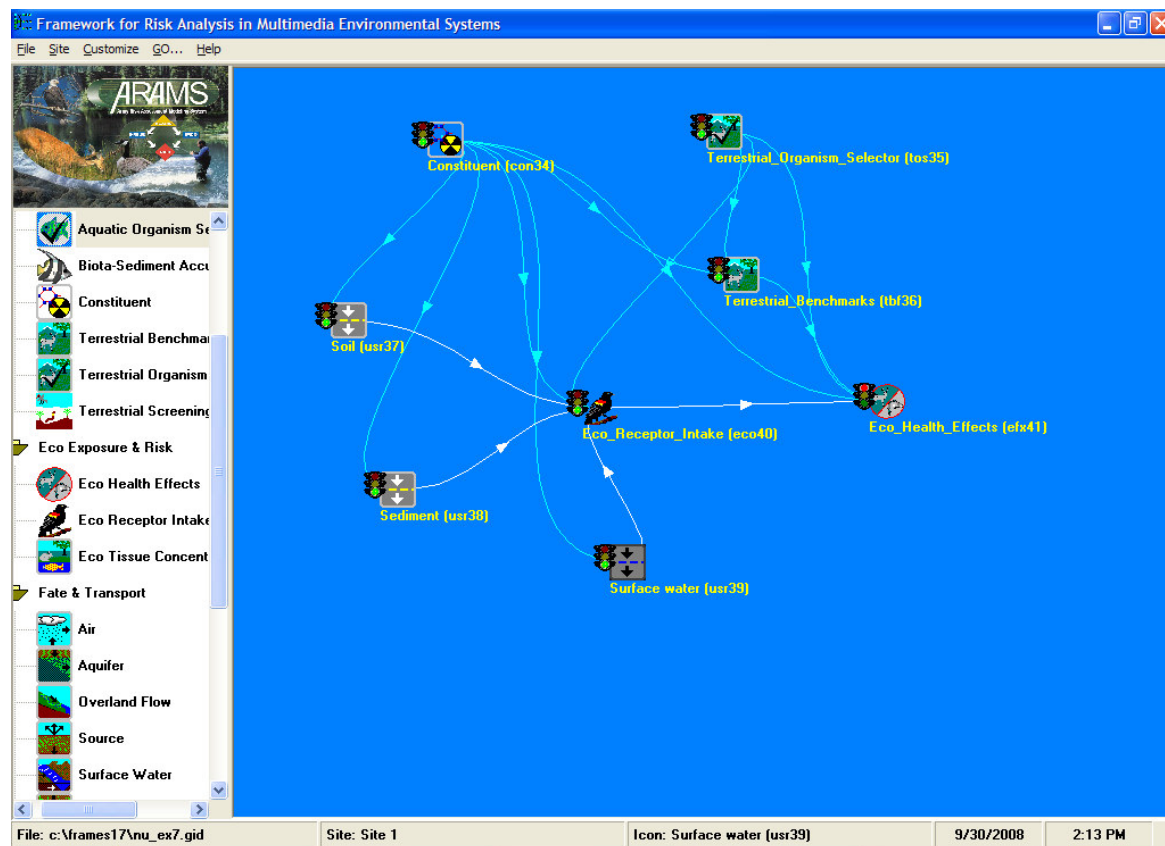


Figure 1. Object workspace for example application

Input Data

- Double-click on “ARAMS Icon” to open “ARAMS info and Disclaimer” window and then select “Accept” to continue.



- Choose “FRAMES” in the ARAMS toolbar to launch FRAMES. (Note: If this is the first time you have used ARAMS, you will need to configure it for FRAMES by selecting “File,” then “***Must Configure Path to FRAMES***” and supplying the path to the “fui.exe” file).
- While ARAMS/FRAMES is running, click “File” from the FRAMES menu and choose “New.” A window titled “Global Input Data Open New” will appear (see Figure 2). In the “File Name” box enter the project name (e.g., “Ex7,” maximum of eight characters) and click “Open” (see

Figure 3). **Do not name the new file “Example7” because it will write over the existing “Example7” file that was distributed with the tutorial.** A window titled “Create New Site” will appear. Next, type the project site name (e.g., “Site 1”) and click “OK” (see Figure 4).

Double-click on the Constituent icon so that the icon appears on the upper left corner of the main screen. Repeat this operation to place the following additional icons into the workspace:

“Terrestrial Organism Selector”

“Terrestrial Benchmarks”

“User-Defined”(three times)

“Eco Receptor Intake”

“Eco Health Effects”

Click on and drag each icon to its respective position on the workspace. Connect the Constituent icon and Terrestrial Benchmarks icon by holding down SHIFT, clicking on the Constituent Icon, dragging the cursor to the Terrestrial Benchmarks icon, and releasing the mouse button. (Note: To remove this line, repeat the steps used to connect it. To remove an icon from the screen, right-click and a menu will appear with various options. Click “Delete” and the icon will be taken out.)

In the same fashion, connect the following pairs of icons:

<i>Constituent</i>	→	<i>Terrestrial Benchmarks (already done)</i>
<i>Constituent</i>	→	<i>User-Defined (one for Soil)</i>
<i>Constituent</i>	→	<i>User-Defined (one for Surface Water)</i>
<i>Constituent</i>	→	<i>User-Defined (one for Sediment)</i>
<i>Constituent</i>	→	<i>Eco Receptor Intake</i>
<i>Constituent</i>	→	<i>Eco Health Effects</i>
<i>User-Defined (Soil)</i>	→	<i>Eco Receptor Intake</i>
<i>User-Defined (Surface Water)</i>	→	<i>Eco Receptor Intake</i>
<i>User-Defined (Sediment)</i>	→	<i>Eco Receptor Intake</i>
<i>Terrestrial Organism Selector</i>	→	<i>Terrestrial Benchmarks</i>
<i>Terrestrial Organism Selector</i>	→	<i>Eco Receptor Intake</i>
<i>Terrestrial Organism Selector</i>	→	<i>Eco Health Effects</i>
<i>Eco Receptor Intake</i>	→	<i>Eco Health Effects</i>
<i>Terrestrial Benchmarks</i>	→	<i>Eco Health Effects</i>

FRAMES should now look something like Figure 1.

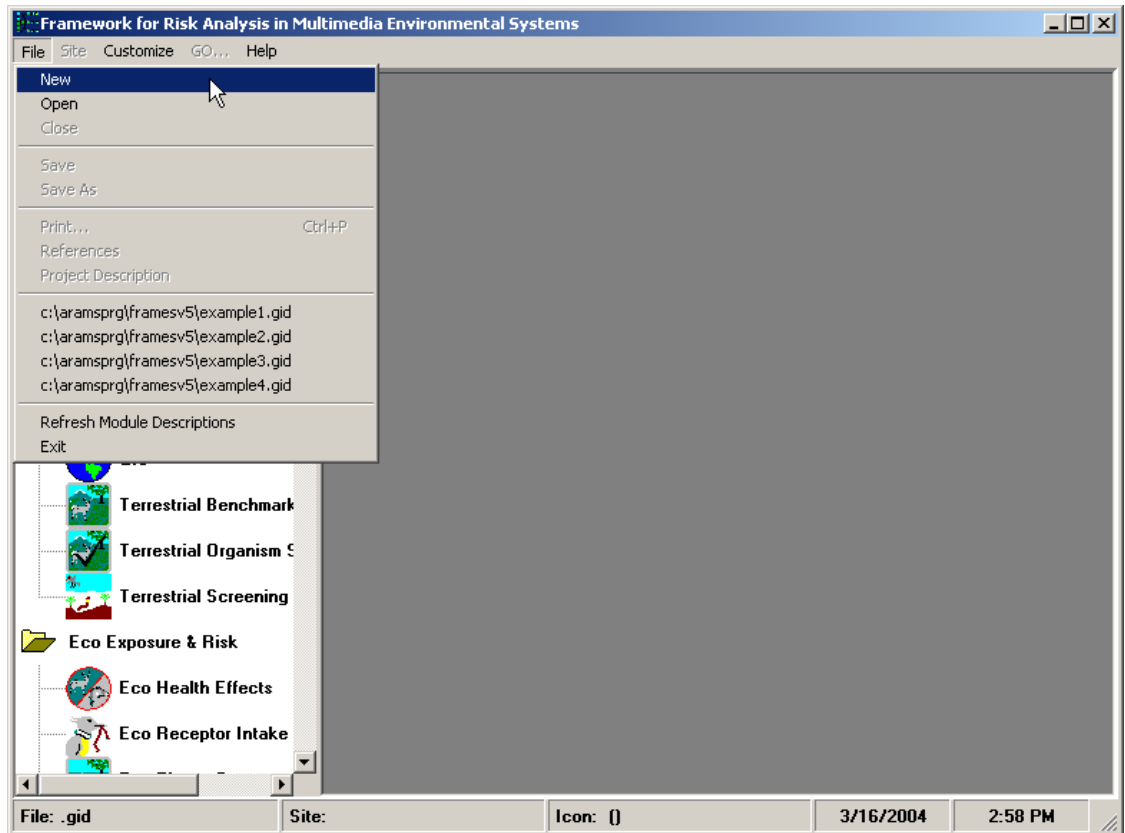


Figure 2. Opening a new file

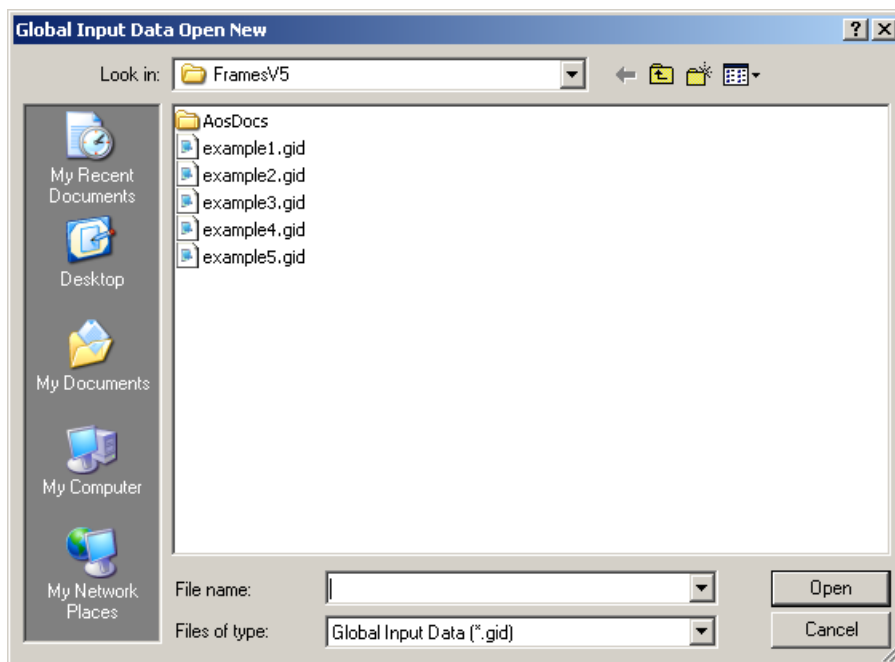


Figure 3. Global Input Data Open New screen (new file window)

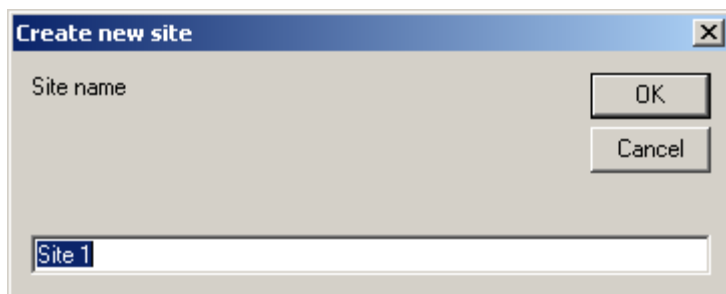


Figure 4. Create New Site screen (input “Site name” box)

CONSTITUENT DATABASE MODULE

Right-click the Constituent icon and choose “General Info” (see Figure 5). When the General Info screen opens, select “FRAMES Constituent Database Selection” in the “Select from applicable models” text box (see Figure 6). Click OK at the bottom of the screen to return to the workspace area. The Constituent icon’s status indicator will now display a red light. Right-click on the constituent icon in the main screen and choose “User Input.” The Constituent Selection screen will open (see Figure 7). The constituent used in this case is DDT. Scroll to select the constituents from the constituents list or use the Search option to search for them.

Click the “Select>>>” button to add each constituent to the selected constituents list. Click “File” and choose “Save and Exit” to return to the workspace screen. The Constituent icon’s status light will change from red to green.



Figure 5. Workspace screen (right-click in the Constituent icon)

Object General Information

Easting coordinate: 0 km
 Northing coordinate: 0 km
 Elevation: 0 km
 User Label: Constituents
 Class: Database
 Group: Constituent
 Object Id: con1
 Previous Model: FRAMES Constituent Database Selection

Select from Applicable Models

- ARAMS-DOD Range Constituent Database
- FRAMES Constituent Database Selection**
- RAIS Constituent Database Selection

Non-applicable Models

Model Description

MODULE VERSION
1.4

MODULE DESCRIPTION
This module allows the user to select constituents of concern. The database also provides some key constituent properties for other modules.
See documentation.

MODULE REFERENCES
Other related sites:
<http://nepas.pnl.gov/earth>

VALID CONNECTIONS
Valid Input Reads
Valid Output Writes (CON Content found in Object Id labeled .GID section)
con

SYSTEM REQUIREMENTS
Operating System: WIN 95 / NT
Processor: Pentium
RAM Memory: Minimum 4MB
Disk Space: Minimum 4MB free disk space

POINT OF CONTACT
Company Name: Pacific Northwest National
Laboratory
Contact Name: Bonnie Hoopes
Mailing Address: PO Box 999
City: Richland
State: WA
Zip Code: 99352

Ok Cancel

Figure 6. Object General Information screen

FRAMES Constituent Database Editor

File Tools Help

Select Constituents of Concern Edit Constituent Properties

Available Constituent Groupings

☐ Chemicals Available (1037)
☐ Radionuclides
☒ Classification Chemical Class All Constituents

Select Constituents for Analysis

Search Next Show CASID

Select >>>

1,1 dichloroethylene
 1,1,1,2-Tetrachloroethane
 1,1,1-Trichloroethane
 1,1,2,2-Tetrachloroethane
 1,1,2-Trichloroethane
 1,1-DCE
 1,1-Dichloroethane
 1,2 Dichlorobenzene
 1,2,3-Trichloropropane
 1,2,4,5-Tetrachlorobenzene
 1,2,4-Trichlorobenzene
 1,2,5,6-DBA
 1,2-benzanthracene
 1,2-dibrom-3-chlor-propane
 1,2-Dichloroethane
 1,2-Dichloroethylene trans
 1,2-Dichloropropane

<<< Remove

DDT

fui.mdb

Figure 7. FRAMES Constituent Selection screen (“Constituents of Concern” tab)

The following is a listing of all data input required by the remaining modules used in this example. *Names of object icons* are in bold, italics, and underlined headings. *Menu items* (displayed by right-clicking on the icon) are shown below the module in bold and indented to the right of the icon names. *Explanations* of data required by each menu item are indented further to the right. To save information for a scenario, select “File” and then “Save” from the main FRAMES menu.

For ease of presentation, the instructions below proceed with selecting module, entering data, running the module, and viewing module output. However, the user should select all object modules prior to entering data for each module.

TERRESTRIAL ORGANISM SELECTOR

General Info

A window titled “Object General Information” will appear. In “Select from Applicable Models,” choose “ARAMS Terrestrial Organism Selector” and click “Ok.” The status light next to the Terrestrial Organism Selector icon should turn red.

User Input

A window titled “ARAMS Terrestrial Organism Selector” will appear. Select “Red Fox” and “Belted Kingfisher” by clicking the checkbox beside the organism’s scientific name as shown in Figure 8. The selector allows users to search for strings that compose the beginning portion of the values for the selected database field. To use this feature, select the appropriate database field that you wish to search from among the “Search Options” radio buttons. Then type part of the name, or the entire name, that you wish to search for into the “Search:” field. As you type, you will notice that all matching strings for the selected database field values appear at the top of the spreadsheet. You can also use the “Find Next” button to find all remaining matches for the string entered into the “Search:” field. The application also has two fields located at the far right of the spreadsheet that serve as web browser links that allow users to obtain additional information on or a picture of the selected organism. Once you have selected all of the target organisms, choose “Save and Exit” from the File menu. The status light next to the Terrestrial Organism Selector icon should turn green.

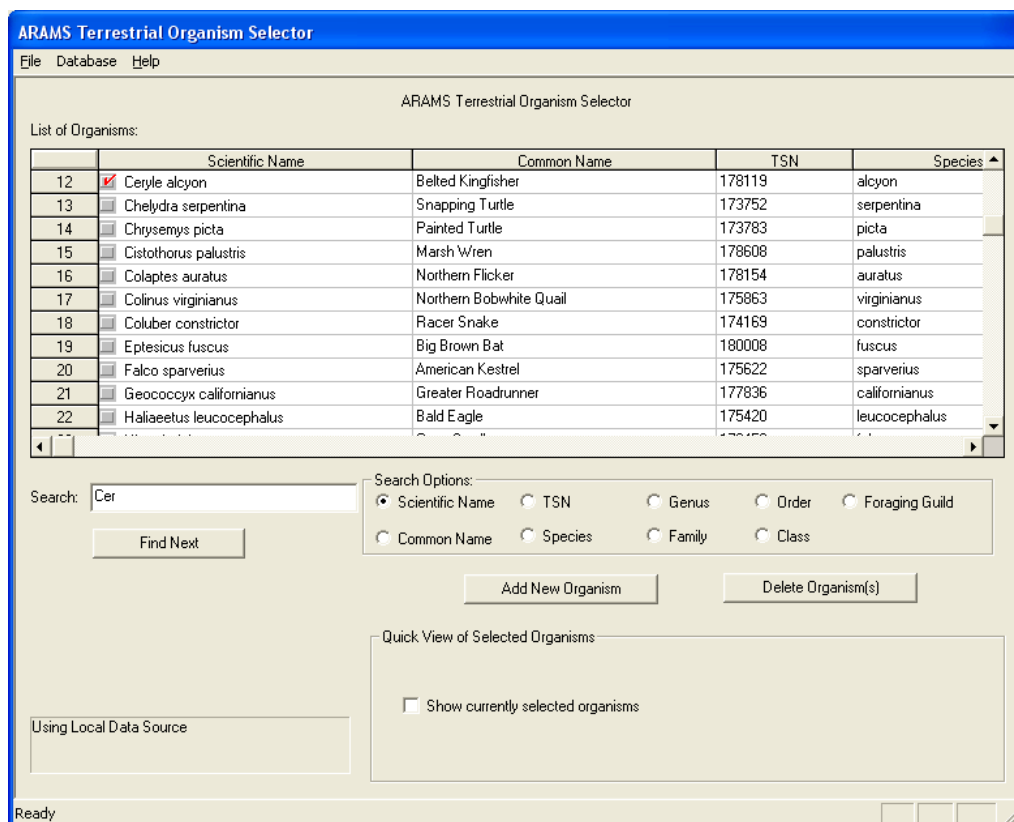


Figure 8. Terrestrial Organism Selection screen

TERRESTRIAL BENCHMARKS

General Info

A window titled “Object General Information” will appear. In “Select from Applicable Models,” choose “TTD - TRVs” and click “Ok.” The status light next to the Terrestrial Benchmarks icon should turn red.

User Input

After the module user interface comes up (see Figure 9), perform any aliasing on the constituents that you desire. By default, the chemicals are aliased to themselves when the user interface first comes up for a new case. The “GID Chemicals” section of the screen contains the list of constituents of concern that were passed from the Constituent database. Alias a constituent by clicking on a constituent in the “GID Chemicals” and then selecting an appropriate alias from the list in the dialog that appears (see Figure 10) and pressing the “Accept” button. The constituents that are displayed on the aliasing dialog are those contained in the TTD database. However, for this example, we will use the default alias. Next, select the desired jurisdictions from the “Jurisdictions” at the top right of the main screen. For this case we will choose the “ORNL” jurisdiction. Click the button labeled “Submit Query to Remote Database.” The available data will be

loaded into a spreadsheet within the “Query Results” section of the main application screen as shown in Figure 11. Select the values to use by placing a check in the box in the last column of the list or by removing the checkmark beside those values that you do not wish to use. You can add your own values by right clicking in the query results spreadsheet and selecting “Add Row” from the popup menu that appears. This will bring up a dialog where you can enter your own TRV information and supply a reference for that information. However, for this example we will use the TTD database data and you should select the two TRVs indicated in Figure 11. Finally, click the “File” menu and select “Save and Exit” from the main application screen to return to the workspace screen. The Terrestrial Benchmarks icon’s status light will change from red to green.

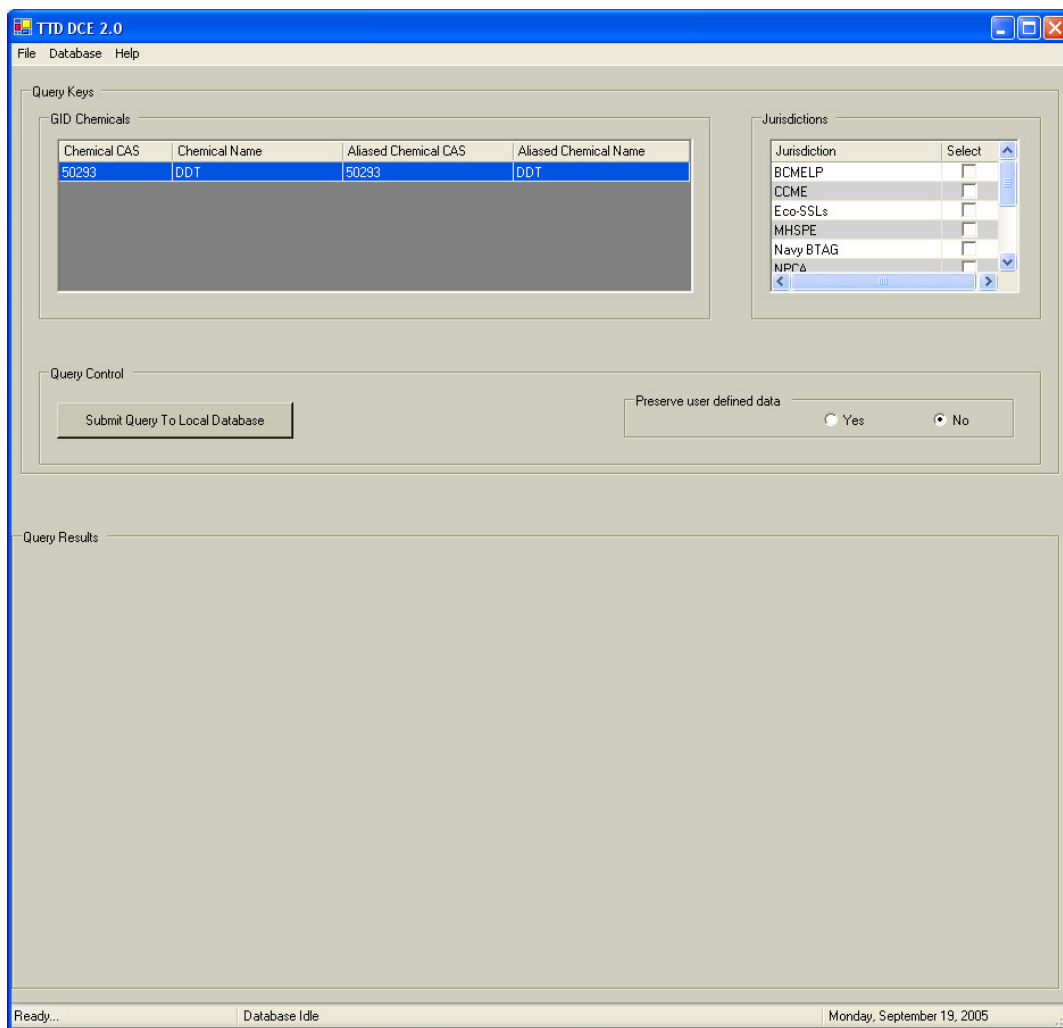


Figure 9. TTD-TRVs main screen

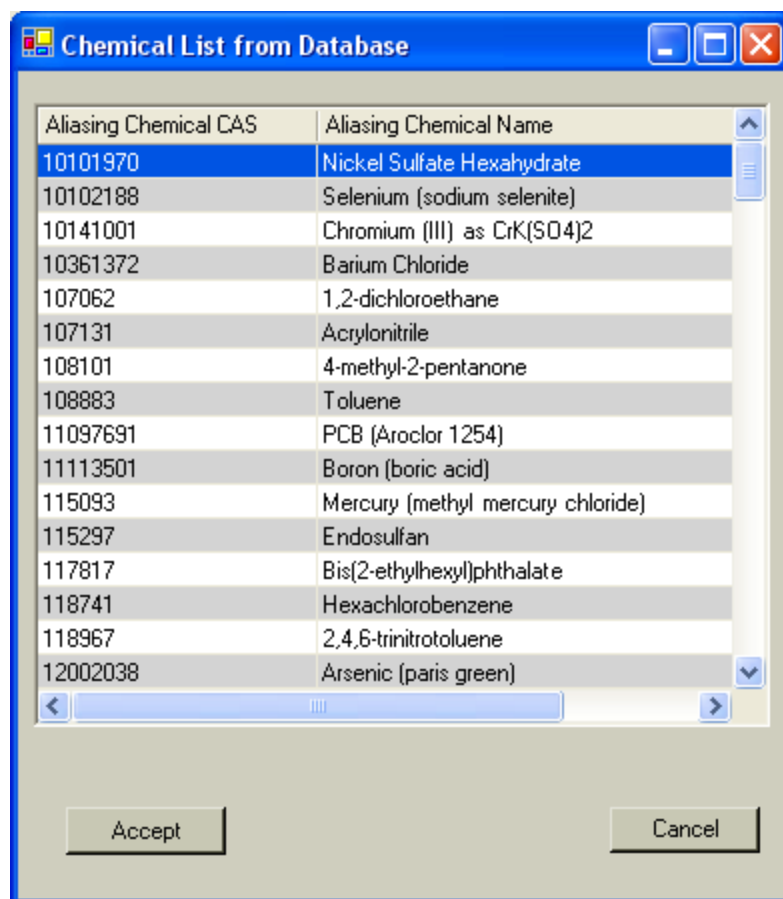


Figure 10. TTD Alias dialog

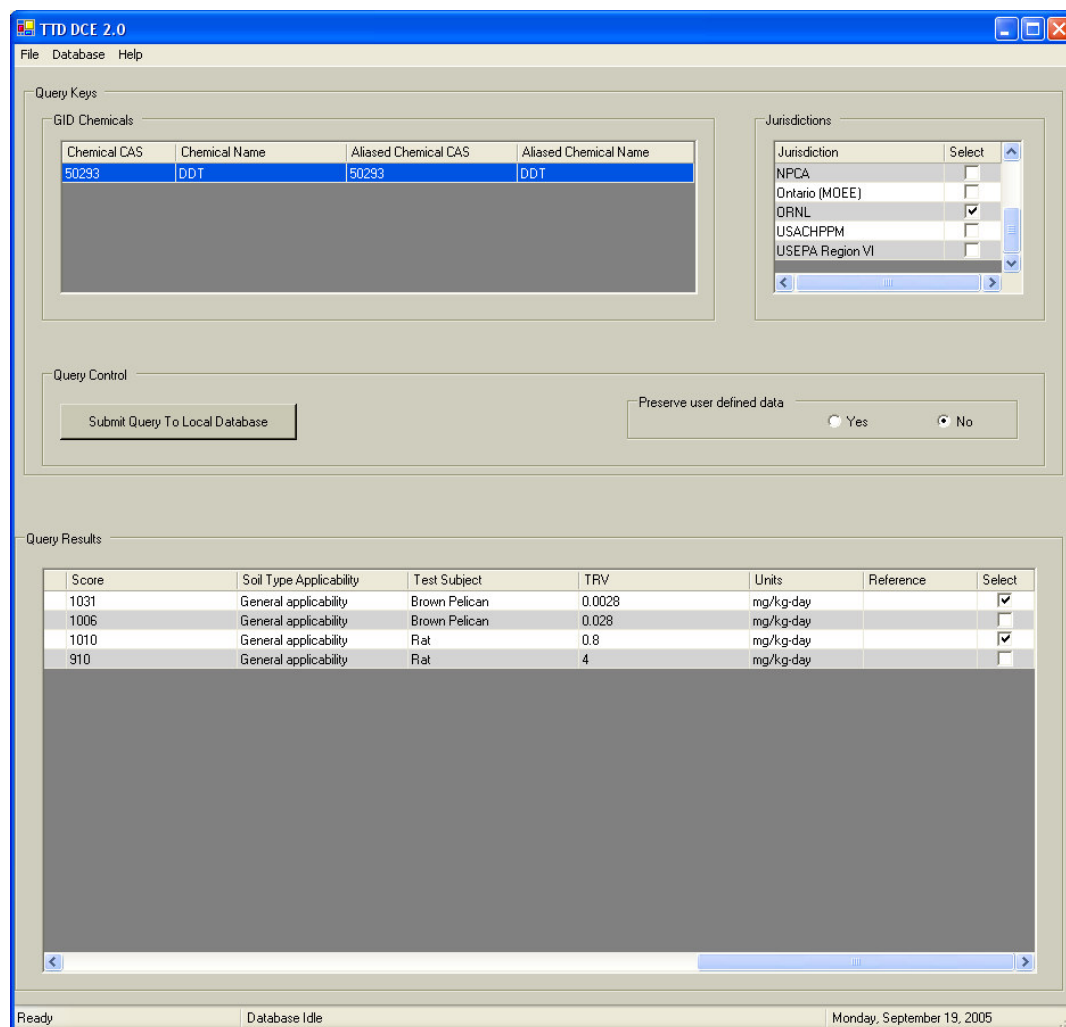


Figure 11. TTD data retrieval

USER-DEFINED

General Info

A window titled “Object General Information” will appear. In the Label text box, input “SCF_Soil.” In “Select from Applicable Models,” choose “SCF Soil-Total Module” and click “Ok.” The status light next to the User Defined icon should turn red. Soil, sediment, and water concentrations can be assessed as total and dissolved. For this example, soil concentrations are assumed to be total (e.g., particulate and dissolved).

User Input

A window titled “FRAMES User Defined Module” will appear. Enter the data as shown in Figure 12. Note that two time points must be entered although this is a steady-state

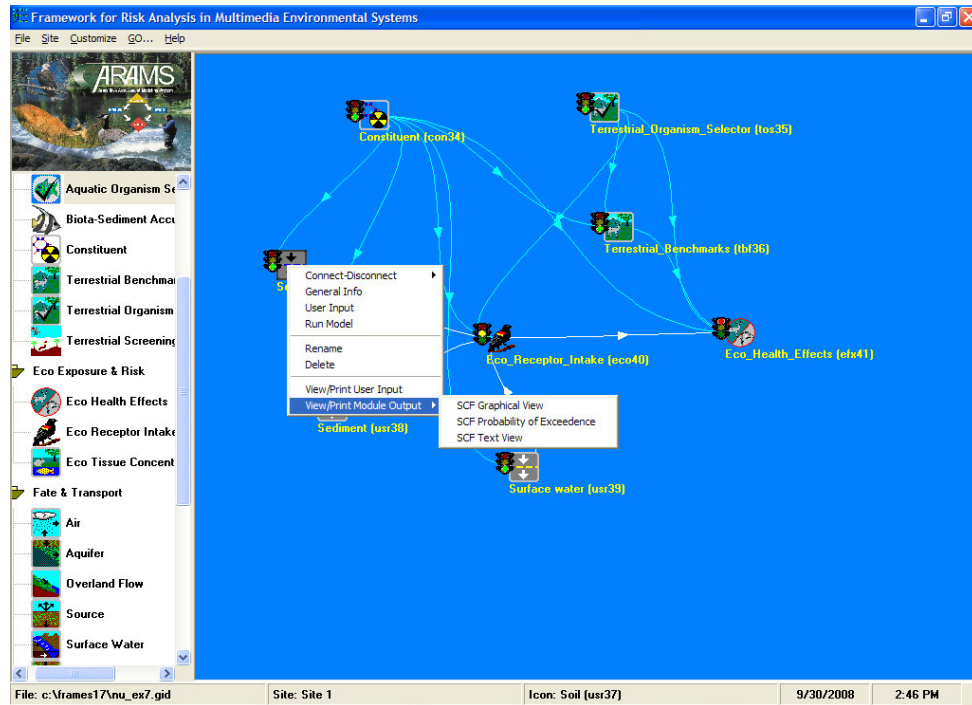


Figure 13. Selecting the Output display format

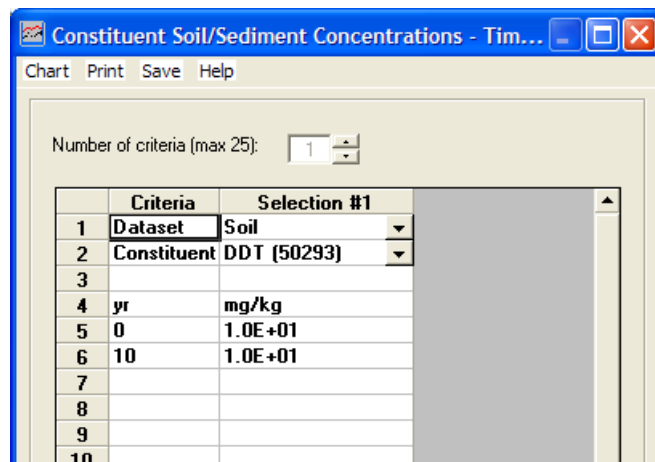


Figure 14. SCF graphical view output selection screen

ECO RECEPTOR INTAKE

General Info

A window titled “Object General Information” will appear. In “Select from Applicable Models,” choose “Terrestrial Wildlife Exposure Model” and click “Ok.” The status light next to the Eco Receptor Intake icon should turn red.

User Input

Make sure that the three User Defined objects have been run before opening the input screen to TWEM. TWEM must have media concentrations passed to it before it interface can be run. Upon opening the TWEM User Input, the main TWEM screen will appear (see Figure 15) and is pre-populated with a project, an area of concern, and the receptors from the Terrestrial Organism Selector. Double left-click the mouse button on the project name (Project #1) in the tree at the top left (or right-click the project name and choose “Edit” from the popup menu). Change the name of the project to “TWEM Example” as shown in Figure 16. Click “Save” and then “Close” to return to the main screen.

Double left-click the left mouse button on the area of concern (AOC #1) in the tree at the top left (or right-click the area of concern and choose “Edit” from the popup menu). Enter 50 acres for the size of the area as shown in Figure 17. Click “Save” and then “Close” to return to the main screen. Note that the concentration data from the User Defined modules were passed to the fields under the “Chemicals” tab on the AOC input screen. Other details, such as moisture content, could be added under this tab.

Left-click the receptor tree to expand the tree to show all receptors as shown in Figure 18. Double click the Red Fox to show the dialog in Figure 19. Note the tabs at the top. Life history parameters are displayed under the General tab as shown in Figure 19. The life history parameters are obtained from default values in the local life history database. The user can change these or view other possible choices by clicking the ellipsis button and selecting another value. The default home range is set to the size of the area of concern resulting in a conservative area use factor (AUF) of 1.0. However, the user could have clicked the ellipsis for home range and selected the value of 1137 ha reported by Jones and Theberge (1982) for a female adult red fox, which would have resulted in an AUF of 0.02 (ratio of AOC size to home range). The default value should remain 50 acres. The AUF is used in the computation of receptor doses.

If the Diet tab is selected, the dialog in Figure 20 appears. The default diet from the Life History database is shown in this example. The user can change and customize the diet. If the “Set Food Concentrations” button is clicked, the dialog in Figure 21 is displayed. Note that the user has several options for calculating food concentrations, including using Measured data, Rule-based (uses one of the next three options in order shown if data exist or Tier I default of BAF=1.0 if not), Regression Model, BAF Model, and Log K_{ow} Model. Rule-based is the default and is used for this example. Each type of model is described in the TWEM help section. If any diet options are changed on this screen, then the “Ok” button should be clicked following changes, and the “Save” button in Figure 20 should be clicked.

After completing TWEM inputs, click “File” and choose “Save and Exit.” The Eco Receptor Intake icon’s status light will change from red to yellow.

Run Model

The model runs in the background. The status light next to the Eco Receptor Intake icon should turn green.

View/Print Module Output

A second menu will appear (see Figure 22). Select TWEM Viewer to view the output screen shown in Figure 23. This screen shows all exposure doses by media for each receptor and constituent as well as the total dose.

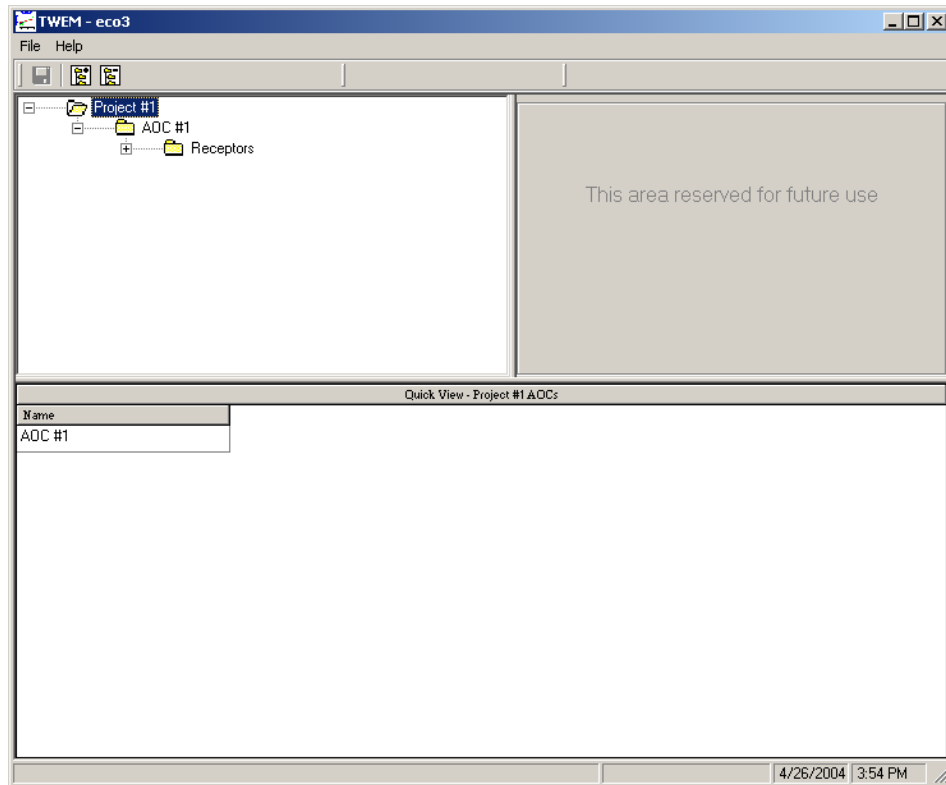


Figure 15. TWEM main input screen

The screenshot shows a "Project #1" dialog box with two tabs: "General" and "Chemicals". The "General" tab is active. It contains several input fields for project information. On the left, there are fields for "Project Name" (containing "TWEM Example"), "Address Line 1", "Address Line 2", "City, State, ZIP" (containing "Vicksburg" and a dropdown for "MS"), and "Country". On the right, there are fields for "Contact" information: "Name" (containing "MDI"), "Phone", and "E-Mail". Below the contact fields are fields for "Analyst" information: "Name", "Phone", and "E-Mail". At the bottom of the dialog are buttons for "Save", "Undo", and "Close".

Figure 16. TWEM project settings dialog

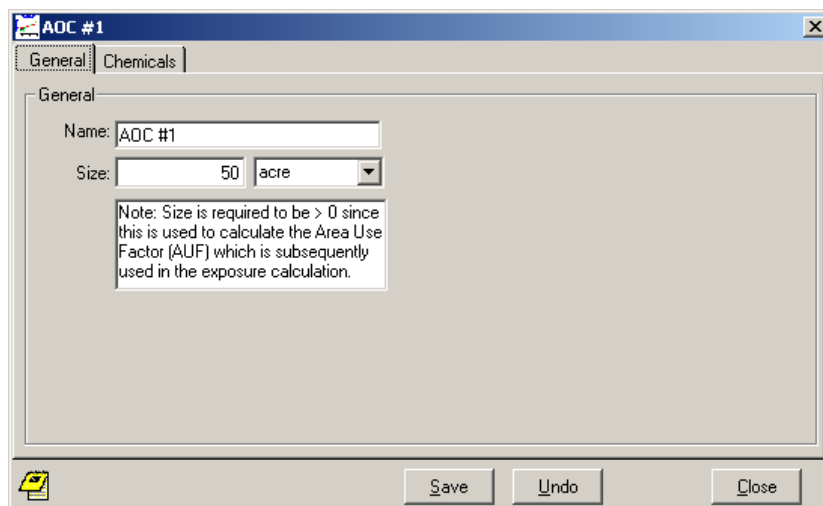


Figure 17. Area of Concern settings dialog in TWEM

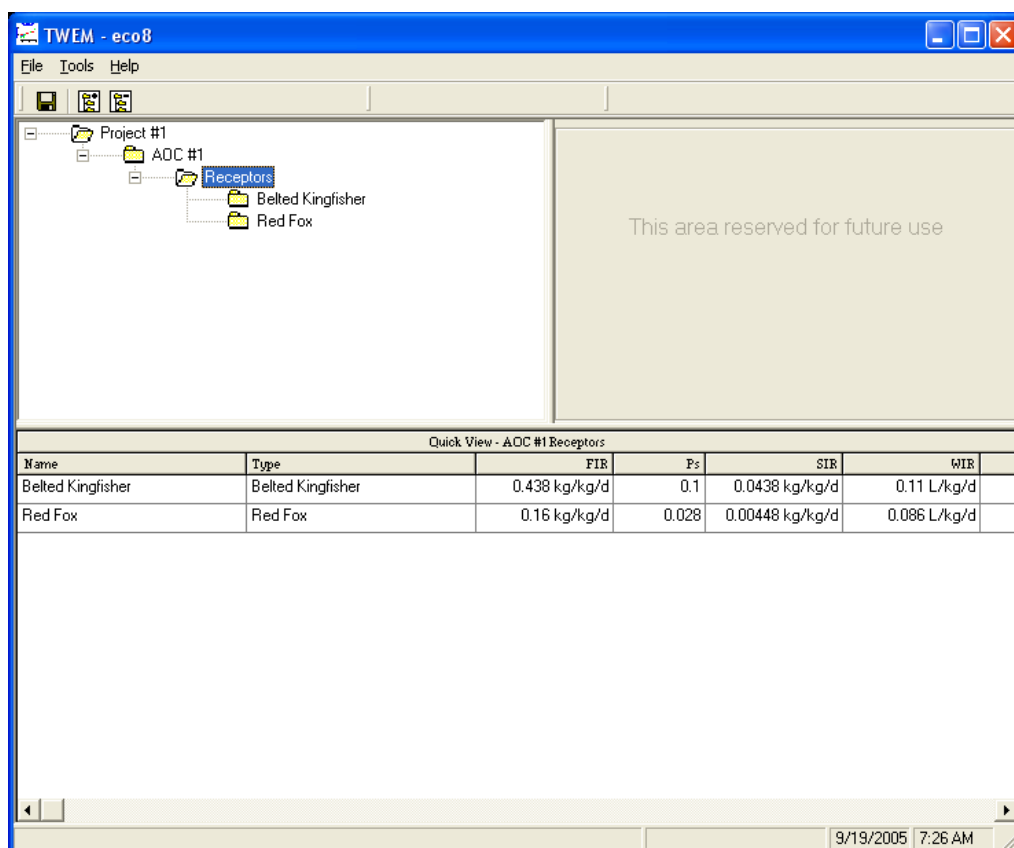


Figure 18. Expanded receptor tree in TWEM

Red Fox

General | Diet | Taxonomy

General

Name: Red Fox

Type: Vulpes vulpes (Terrestrial Organism)

Life History Parameter:	Value	Units	Type	Reference	Comments
Food Ingestion Rate (FIR):	0.160	kg/kg/d	Tier 1 Default	Sargeant, 1978	dry weight basis reported / Measured / Ca
Soil Proportion of Food (Ps):	0.028		Tier 1 Default	Beyer et al., 1994	Measured Value
Water Ingestion Rate (WIR):	0.086	L/kg/d	Tier 1 Default	Calder and Braun, 1983	Calculated
Body Weight (BW):	4.530	kg	Tier 1 Default	Default	average adult weight
Home Range (HR):	50.000	acre	Tier 1 Default	same as ADC size	

AUF=1. Spatial

Save Undo Close

Figure 19. Red Fox receptor input screen in TWEM

Red Fox

General | Diet | Taxonomy

Diet

Reference: EPA, 1998 Comments: Conservative dietary composition assumed to maximi

Select Diet Customize Diet Set Food Concentrations

Food	Pi	Food	Chemical	Calculation Type	Food Conc.	Pathway
Small Mammals, Small Man	1	Small Mammals, Small Man	DDT	Rule-based	17.27215	SOIL

Save Undo Close

Figure 20. Diet screen in TWEM

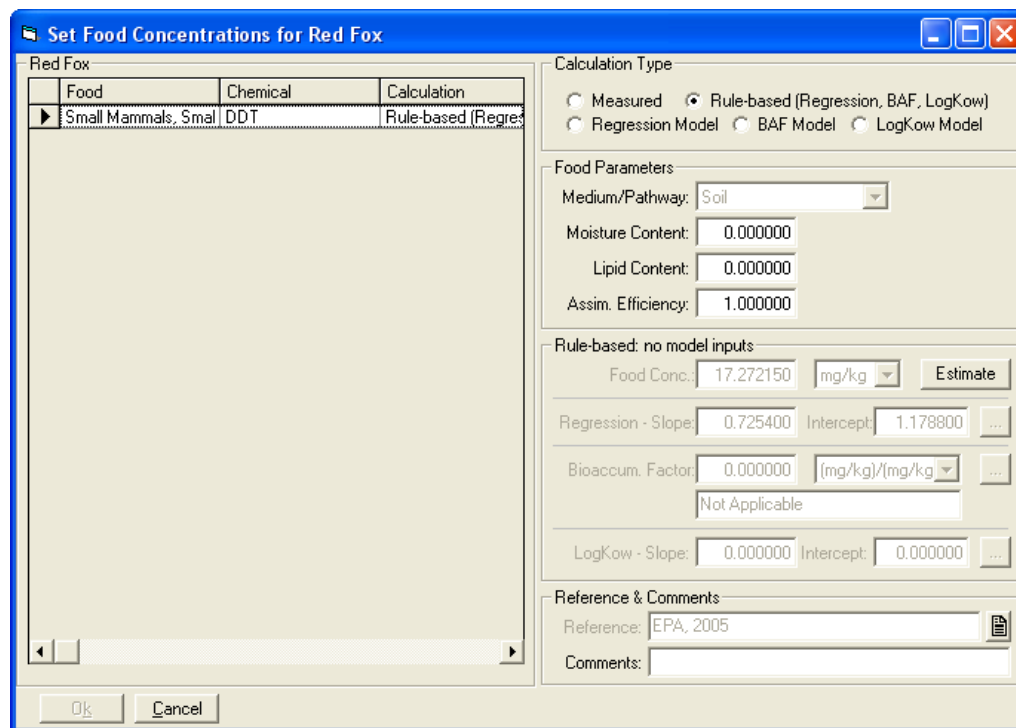


Figure 21. Set Food Concentrations screen in TWEM



Figure 22. Select the output display format for Eco Receptor Intake

Exposure Levels

AOC #1

Receptor	CASID	Chemical Name	Soil	Sediment	Water	Food	Total	Units
▶ Belted Kingfisher	50293	DDT	0	0.438	0.11	0.438	0.985	mg/kg/d
Red Fox	50293	DDT	0.0448	0	0.086	2.76	2.89	mg/kg/d

Exposure Details (Food Concentrations)

Food	Exposure	Conc.	Model	Short Ref.	Full Ref.
▶ Fish, Fish	0.4375	1 mg/kg	BAF	Tier 1 Default	

References related to Selected Receptor

Parameter	Short Ref.	Full Ref.
▶ WIR	Calder and Braun,	Calder, W. A., and E. J. Braun. 1983. "Scaling of Osmotic Regulation in Mammals
FIR	White, 1936	White, H. C. 1936. "The Food of Kingfishers and Mergansers on the Margaree
Ps	User-entered	
Body	Default	Default value; no reference; see comments for details
Home	same as AOC size	
Diet	EPA, 1998	EPA. 1998. Guidelines for Ecological Risk Assessment. Risk Assessment Forum,

Print this page

Print all pages

Export to Excel

Figure 23. TWEM output viewer

ECO HEALTH EFFECTS

General Info

A window titled “Object General Information” will appear. In “Select from Applicable Models,” choose “WEAP Terrestrial Organism Intake HQ” and click “Ok.” The status light next to the Eco Health Effects icon should turn red.

User Input

////A window titled “Wildlife Ecological Assessment Program” will appear as shown in Figure 24. In the right panel labeled “Terrestrial Intake Assessment,” click in the check box to the left of “Toxicity Reference Value.” In the data tree at left, click on “Toxicity Reference Value Jurisdictions” and a list of available jurisdictions will appear at the right side of the dialog. From this list choose (by clicking on) “ORNL” (see Figure 25).

Click “File” and choose “Save and Exit” to return to the workspace screen. The Eco Health Effects icon’s status light will change from red to yellow.

Run Model

The model runs in the background. The status light next to the Eco Health Effects icon should turn green.

View/Print Module Output

A second menu will appear. Select the “HQF Graphical View” to view a screen for selecting output like Figure 26. Click “Chart” to generate an Excel plot like shown in Figure 27. Note that the eco hazard quotient (EHQ) in the output is reported for years 1 and 2. This is due to the fact that TWEM is currently not a time-varying model. However, since the Eco Health Effects viewer must handle situations that may be time varying and can produce time-varying plots, the viewer takes the only data point in time and assumes it is the same at a second time point. By scrolling down the Excel sheet, the user can view all the other EHQ values for each media and each receptor.

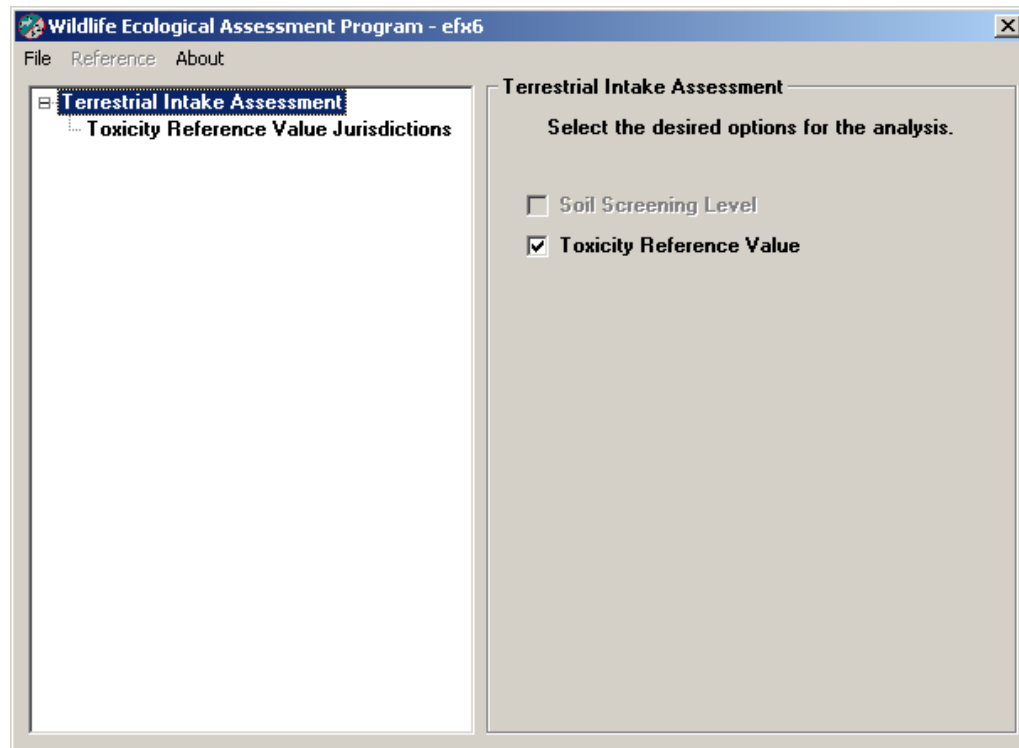


Figure 24. Wildlife Ecological Assessment Program main screen

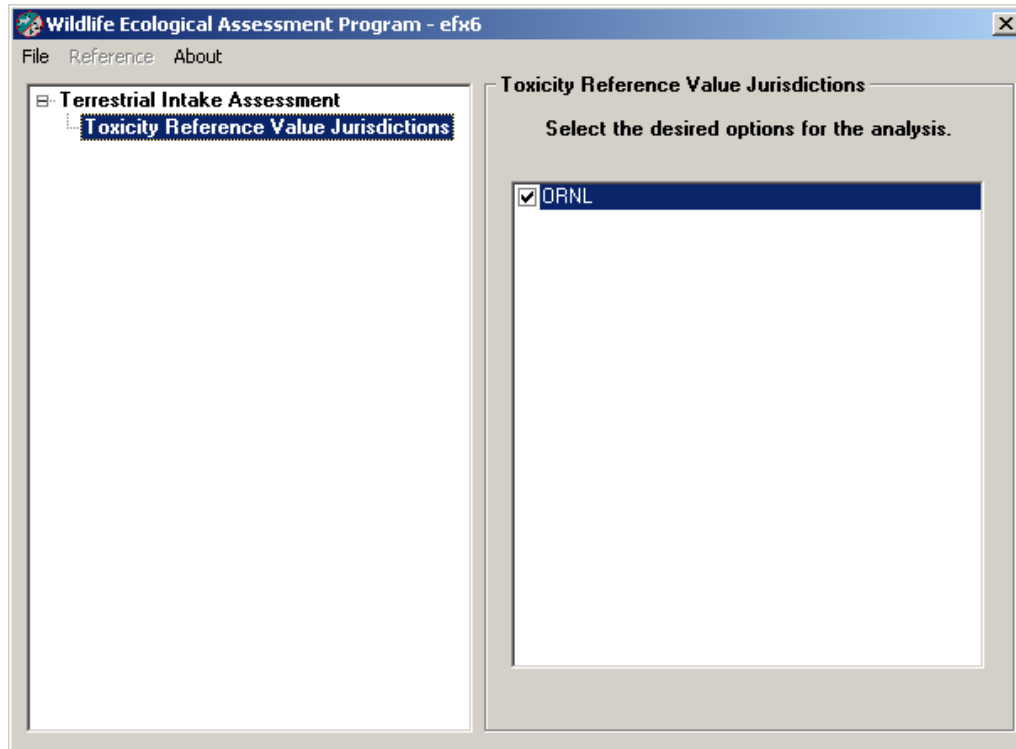


Figure 25. Wildlife Ecological Assessment Program (Toxicity Reference Value Jurisdictions)

Figure 26. Eco Health Effects, HQF Graphical View output selection screen

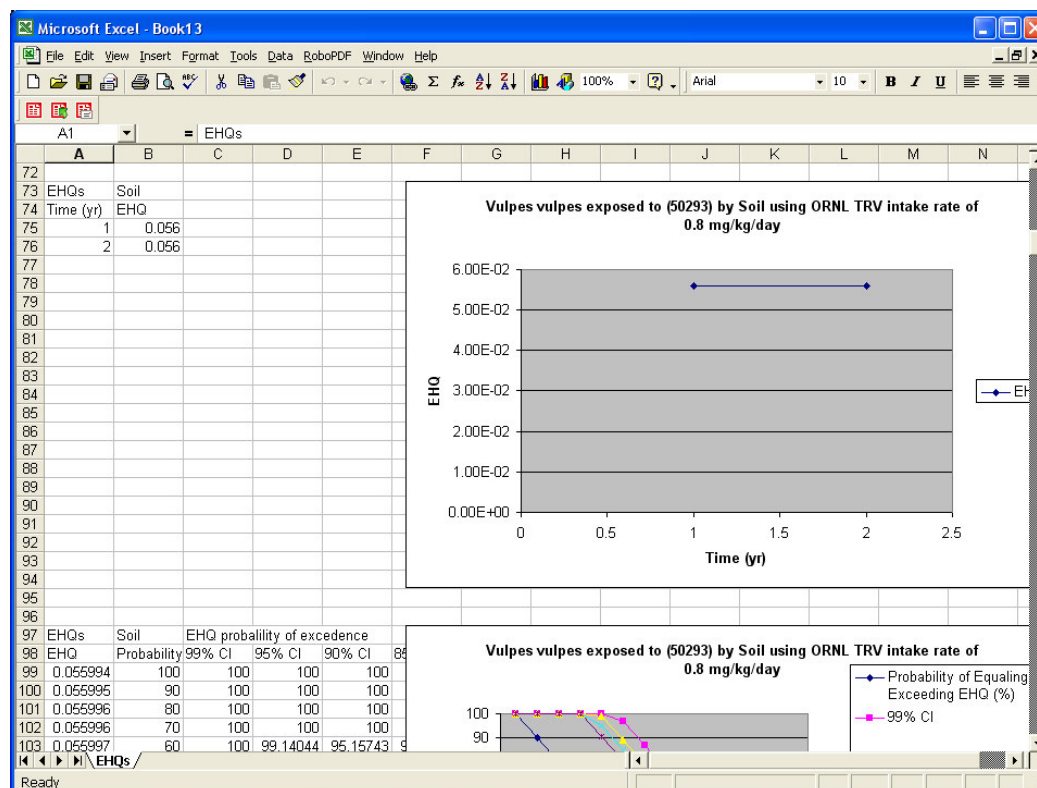


Figure 27. Eco Health Effects Output (Excel plot)